MFI, Gas, NMEA Single and Twin
Inboard & IO to 1000 HP, All Outboards

This manual (part # 9000-006-00) applies to the following product part numbers:

1) 9000-20B-1
2) 9000-20B-2
3) 9000-231-1
4) 9000-231-11
5) 9000-231-2
6) 9000-231-21
7) 9000-33C-1
8) 9000-33C-11
9) 9000-33C-2
10) 9000-33C-21
11) 90000-20B-1
12) 90000-231-1
13) 90000-23111
14) 90000-231-2
15) 90000-23121
16) 90000-33C-2
17) 90000-33C21
18) 9900-231-1
19) 9900-20B-2
20) 9900-231-2
21) 9900-231-21
22) 9900-33C-11
23) 9900-33C-2
24) 9900-33C-21

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TROUBLESHOOTING

Series 7000/8000/9000 Multifunction Instrument

BEFORE CALLING FOR ASSISTANCE, COMPLETE THESE TROUBLESHOOTING CHECKS AND RECORD YOUR FINDINGS. TECHNICAL SUPPORT REQUIRES THIS INFORMATION BEFORE A RETURN AUTHORIZATION WILL BE ISSUED. IT TAKES ABOUT 20 MINUTES AND IS VERY IMPORTANT IN ANALYZING SYSTEM PROBLEMS.

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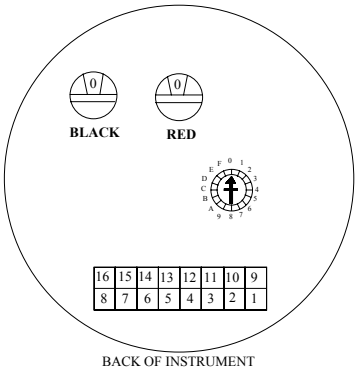
Before starting, record Instrument model number and switch settings.

MODEL # _____

SERIAL # _____

Arrow_____ Black_____ Red_____



FAULT	PROBABLE CAUSE	SEE SECTION:
Blank LCD Display	Wiring	Section II
No back-lighting	Wiring/bulb failure	Section III
Low Totalizer Reading, over 10%	Calibration	Calibration sheet
	Sensor orientation/failure	Installation sheet
High Totalizer Reading, over 10%	Incorrect/defective sensor	Operations
	Incorrect switch settings	Manual page
	Suction leak	Section VII
Fluctuating GPH Readings	Suction leak	Section VII
	Low RPM operation	Section IX
No GPH or Totalizer Reading	Wiring/Instrument failure	Section II and IV
	Sensor orientation/failure	Installation sheet
High, Low or No Tachometer Reading	Wiring	Installation sheet
	Calibration	Calibration sheet
Fluctuating Tachometer	Wiring/continuity	Section VI
	In synch w/engine	
Wire Harness Continuity Test		Section V

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I. VERIFY SWITCH SETTINGS

1. Turn Instrument power OFF, then ON.

2. For 2 seconds after powering up, the Instrument will show all 8s. During This time quickly cycle the Totalizer Reset Switch from its' run position too reset and back twice. Leave it in the run, or off position.

Note: For 20 seconds, the four display windows show the following:

Hours Window: **A**lternates between the 3 digit software version, (X.XX) and a 5 digit code number, (XXXXX).

RPM Window: Shows RED switch setting, (Refer to tachometer calibration sheet).

GPH Window: Shows ARROW switch setting, for Sensor model selected.

Gallons Window: Shows BLACK switch setting, (Refer to the Calibration sheet).

II. SUPPLY VOLTAGE and GROUND TEST

1. Measure voltage between the RED power wire on pin 9, and the BLACK Instrument ground wire on pin 5. This reading should be approximately 12 VDC, but not lower than 10 VDC. _____VDC

2. If 12 VDC is not present, measure between the RED power wire on pin 9 and a known good ground in the instrument panel. If you measure 12 to 14 VDC between the Red wire and ground, there may be an Instrument ground problem. _____VDC

NOTE: Some applications use both pins 1 and 9 for Instrument power.

3. If 12 to 14 VDC is not present in steps 2 or 3, check wiring, switches, fuse, and the 12 VDC power source.

III. LED BACK-LIGHTING WIRING TEST

1. Measure voltage between the ORANGE, wire on pin 4 and the BLACK wire on pin 5, for 75/7600(0) and 85/8600(0) series Instruments. On 95/9600(0) series Instruments, measure between pin 4, and the BLACK/ORANGE wire on Pin 12. _____VDC

2. If 12 VDC is not present, measure between the ORANGE wire on pin 4 and a known good ground in the instrument panel. If you measure 12-14 VDC, there is a power supply problem to pin 4, or a ground connection problem to pins 5 or 12.

IV. SENSOR(S) TEST

1. With engine(s) idling, measure and record voltage between the RED power and BLACK ground wires on the Port Sensor. Voltage should be 12 to 14 VDC. _____VDC

2. Move the voltmeters' negative lead to the WHITE signal wire. With engine idling, measure and record the voltage reading. It should be approximately 5 to 7 VDC, about ½ of the reading in step 1. _____VDC

3. Stop the engine while observing your voltmeter. Readings should fluctuate between a high of 9 to 12 VDC, and a low of 0 to 4 VDC as the sensors' turbine slows to a stop.

NOTE: This may not be seen on digital voltmeters. _____VDC

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4. With engine(s) idling, measure and record voltage between the RED power and BLACK ground wires on the Starboard Sensor, (If used). Voltage should be 12 to 14 VDC.

5. Move the voltmeters' negative lead to the White (Signal) wire. With engine idling, measure and record the voltage reading. It should be approximately 5 to 7 VDC, about ½ of the reading in step 1. _____VDC

6. Stop the engine and observe the voltmeter. Voltage readings should fluctuate between a high of 9 to 12 VDC, and a low of 0 to 4 VDC as the Sensors' turbine slows to a stop.

NOTE: This may not be seen on digital voltmeters.

7. The Sensor(s) may be defective if voltage readings in steps 3 & 5 remain constant.

8. If signal voltages in steps 3 & 5 are ok, go to the backside of the MFI Instrument. With engine(s) running, measure and record voltage readings across the Red & White, (Port Sensor) and Red & Brown, (Starboard Sensor) signal wires. The MFI voltage readings should match the Sensor readings. This verifies that the Sensors' signal is reaching the MFI. If not there is a wiring problem.

V. CONTINUITY TEST

1. Continuity testing requires access to the back of the Instrument and an Ohmmeter. It verifies that wires are not broken, shorted to ground, another wire, or to power. Before starting, secure all power, and disconnect the Molex connector from the Instrument. You will be testing the WHITE, BROWN, YELLOW, VIOLET, and BLACK wires.

2. Disconnect the WHITE and BLACK wire harness conductors from the WHITE and BLACK Port Sensor wires. Connect a jumper from the WHITE wiring harness conductor to a known good ground. At the Molex connector, connect an Ohmmeter lead to its' WHITE wire. Connect the other Ohmmeter lead to a known, good ground. The Ohmmeter should read approximately 0.1 to 3 Ω. _____ (Ohm Reading)

3. Disconnect the BROWN and BLACK wire harness conductors from the WHITE and BLACK Starboard Sensor wires. Connect a jumper from the BROWN wiring harness conductor to a known good ground. At the Molex connector, connect an Ohmmeter lead to its' BROWN wire. Connect the other Ohmmeter lead to a known good ground. The Ohmmeter should read approximately 0.1 to 3 Ω. _____ (Ohm Reading)

4. Disconnect the YELLOW wire harness conductor from the Port Tachometer Sender. Connect a jumper from the YELLOW wiring harness conductor to a known good ground. At the Molex connector, connect an Ohmmeter lead to its' YELLOW wire. Connect the other Ohmmeter lead to a known good ground. The Ohmmeter should read approximately 0.1 to 3Ω. _____ (Ohm Reading)

5. Disconnect the VIOLET wire harness conductor from the Starboard Tachometer Sender. Connect a jumper from the VIOLET wiring harness conductor to a known good ground. At the Molex connector, connect an Ohmmeter lead to its' VIOLET wire. Connect the other Ohmmeter lead to a known good ground. The Ohmmeter should read approximately 0.1 to 3Ω. _____ (Ohm Reading)

VI. TACHOMETER PROBLEMS

Note: Refer to the engine owners' manual, wiring diagram, installation, and calibration instructions for parts A, B, & C below.

A. NO READING.

1. Check continuity of the YELLOW and VIOLET Tachometer signal wires, (Section V). Verify that the tachometer signal wires are connected at the correct signal output point.

B. HIGH OR LOW READINGS.

1. Verify that Tachometer is calibrated correctly.

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C. FLUCTUATING READINGS.

1. Listen to your engine(s). If engine speed cycles up and down, (when idling or underway) the tachometer reading will follow. This does not indicate a problem with the Tachometer, but may indicate engine problems.

2. Verify that wiring connections are tight, clean and dry. Check continuity while shaking the wires. Ohm readings should be near zero and remain steady.

3. Verify that the tachometer signal wires are connected at the correct signal output point.

VII. PULSATION PROBLEMS

A stiff anti-siphon valve, sticking carburetor float or miss-plumbed Pulsation Damper(s) can cause fluctuating GPH readings. These are most pronounced at low Rpm's and tend to disappear around mid throttle. They are annoying, but won't affect totalizer accuracy. To eliminate, repair or replace any defective parts, or re-plumb dampers according to the Fuel Flow Schematic Instructions.

VIII. FINDING FUEL SYSTEM VACUUM LEAKS

Fluctuating GPH and High Totalizer Readings are usually caused by a small vacuum leak between the fuel tank and fuel pump inlet. Fluctuations tend to be between 2 and 4 GPH. These vacuum leaks also affect totalizer accuracy, causing it to read 15 to 100% high. Larger leaks produce greater fluctuations and higher readings. They generally do not affect engine performance.

Finding suction leaks can be time-consuming. When approached properly, they can usually be found and repaired quickly. Two common places for suction leaks to occur are at the primary fuel filter - water separator, and/or a loose valve stem packing nut.

Remove the filter housing and coat all o-rings, gaskets and sealing surfaces with a medium to heavy grease, **(Do not use oil)** and reassemble. Grease all valve stem packings and gently tighten gland nuts. Don't over tighten, valve handles should turn freely. Tighten all hose clamps and compression fittings. Don't over tighten. Run the engine for 5 to 10 minutes observing GPH readings. If you've found the problem, fluctuations should be reduced to less than ½ GPH.

If the problem persists, temporarily install a clear piece of fuel resistant hose downstream of the forward flow sensor. Run the engine and watch for a stream of small bubbles in the clear hose, or an occasional larger bubble. Sometimes shining a light through the hose makes bubbles easier to see.

Observe the clear hose while shaking the fuel lines. If the bubble stream continually increases or decreases you've found the leak area. Repair or replace as needed. If this occurs one-time, you probably dislodged some trapped air.

If the leak hasn't been found, the last step is to inspect each pipe joint. Thread sealant should be visiable around each joint. If not, that joint is suspect and must be resealed. After resealing run the engine for a few minutes to purge any remaining air. There should now be bubble free fuel running through the clear hose. If bubbles are still present a leak was missed. Recheck your work. After all the leaks are stopped, remove the clear hose.

IX. FUEL FILTERS

A dirty fuel filter, or one that is too fine (1-25 micron) will draw vapor bubbles out of the fuel, causing fluctuations and high readings. Replace it with a new 30-micron or coarser filter.

X. FLOW SENSOR ORIENTATION

Sensor orientation is critical for proper operation. All Sensors have their inlet and outlet ports clearly marked (**IN / OUT** or ➔ ➔). This identifies fuel flow direction. The Sensor must be, "Plumbed" correctly for it to operate properly. There is an additional single arrow on the Sensor body. It is crucial that this single arrow points up ↑.

IX. LOW RPM OPERATION

At idle, under a no load condition, it is common for GPH readings to fluctuate slightly.

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X. NMEA 0183 Input, MPG, (Nautical) Miles per Gallon Problems:

Error Codes

Display	Reason	Cause
OFF	No signal activity present on NMEA 0183 terminals for four seconds	GPS / LORAN-C OFF NMEA OUTPUT not selected Leads not connected A & B leads reversed
- - -	Receiving valid NMEA 0183 Version 1.5 or 2.0 message, speed message invalid.	GPS satellite reception is poor GPS / LORAN-C in startup mode
- 0 -	Fuel flow reading below 0.1 GPH (LPH) (twin-both engines). Valid NMEA 0183 speed message present.	Engine(s) not running Fuel flow reading problem.
Er1	Some pulsing activity present. No valid NMEA 0183 message received in last four seconds.	Leads connected to wrong source GPS / LORAN-C set to NMEA 0180 or 0182 A & B leads reversed.
Er2	NMEA message detected. Missing "GPRMC" or "LCRMA" sentence.	GPS / LORAN-C incompatible with NMEA 0183, ver. 1.5 or newer

1. An **OFF** display in the GPH/MPG window indicates the FloScan Instrument isn't receiving a NMEA 0183 speed signal from the GPS. Check wiring connections to the GPS, and verify that it is turned on.

2. A Dash, Dash, Dash, (**- - -**) display indicates the GPS is in startup mode, or satellite reception is poor.

3. A Dash 0 Dash, (**- 0 -**) display indicates a valid NMEA 0183 speed message is present, but that fuel flow readings are so low the FloScan Instrument is unable to compute a meaningful MPG figure. Dash 0 Dash, (**- 0 -**) may be displayed when motoring at low speeds, or when slowing down. When slowing down the FloScan Instrument may display ever-increasing MPG readings, go to Dash 0 Dash, (**- 0 -**) and start redisplaying ever-increasing readings again.

4. **Er1** indicates that the FloScan Instrument isn't receiving a valid NMEA 0183 message from the GPS. Check wiring connections to the GPS.

5. **Er2** indicates that, "GPRMC" or "LCRMA" is missing from the GPS NMEA 0183-speed signal message. Verify the GPS sending a NMEA 0183 version 1.5 or newer signal.

This concludes system testing. If problems with your system persist, contact FloScan Technical Support with testing results

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INSTALLATION PLANNING

READ ME FIRST - Mechanical & Electrical Installation Planning Saves Time!

FloScan systems are not difficult to install. Installing one requires only basic electrical & mechanical skills. With forethought and planning, your system will be installed with few problems.

I. Installation Preparation:

Review the mechanical installation instructions, then survey your vessel. Determine where the Sensor(s), Pulsation Damper(s), (if used) Switches and Instruments are to be mounted. Place them at their approximate locations. Measure fuel line lengths between system components, (Primary Filter, Sensor(s), Damper(s), Engine, and Fuel Tank). Determine fitting sizes and type of fittings needed for each plumbing connection, (JIC, SAE, NPT, NPTF, or Hose Barb).

FloScan Gasoline, "Hi-Flo" system components have ½" Female NPT ports.
FloScan Gasoline, "Lo-Flo" system components have ¼" Female NPT ports.

Review the electrical installation instructions. Open and survey your vessels wire ways and run 3-conductor cables from each sensor to the instrument. Tachometers require 1 or 2 additional conductors. If there's an existing tachometer, its signal wires can be used.

II. Mechanical Installation:

Install or mount the Sensor(s), Pulsation Damper(s), (If required) Instruments and Switches, (Reset, MPG, Port/Starboard, Synch).

III. Plumbing:

Mount sensor(s) where they're to be installed. On installations using **Fabric Braid A-1 Fuel Hose** install the correct HB X MNPT fitting into each sensor. Always assemble fittings using a fuel proof pipe thread sealant. **Never use Teflon Tape**. Use a hose cutter or knife to cut the fuel hose. Next install the hose onto the barb fittings. Hose should not be twisted, have adequate slack, an ample radius at all bends and be supported at reasonable distances, approximately 2-4 feet. When clamping hose onto the barbs, use 2 narrow or 1 wide stainless hose clamp on each hose end.

Wire Braid A-1 Aeroquip Type Fuel Hose or Hydraulic Hose: Mount the sensor(s) or sensor assemblies where they're to be installed. Mark the hose where it is to be cut. Remove hose and bring it to a hydraulic shop. Have them cut the hose and install hose ends. Reinstall the hoses and install the correct fitting into each sensor or sensor assembly. Always assemble fittings using a fuel proof pipe thread sealant. **Never use Teflon Tape**. Hoses should not be twisted, have adequate slack, an ample radius at all bends and be adequately supported at reasonable distances, approximately 2-4 feet. AP-50 copper sealing washers, (Connie Seals) or Flaretite seals may be required to seal JIC & SAE fittings.

IV. Electrical Installation:

Run cables between Sensor(s) and Instrument(s). Cables must be adequately supported at reasonable distances, approximately 2-4 feet. Wire Terminations—Referring to the wiring diagram. Connect Sensor, Instrument and Switches to their respective wires with crimp type butt or ring connectors. Always cover connectors and wire ends with heat shrink tubing.

V. System Start-Up:

Prime the fuel system and check for leaks. Start and run your engines. Look for leaks and other installation problems. If system is not operating properly refer to the Troubleshooting Instructions and correct any deficiencies.

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VI. Calibration:

When system is running properly, refer to the calibration instructions and calibrate your system.

USCG approved fuel hose with either fabric or wire reinforcing braid meet the following standards:

Hose Marking	Permeation Rating	2½ Minute Fire Test
USCG Type A-1	**100g/m²/24hrs.**	**Required**
USCG Type A-2	**300g/m²/24hrs.**	**Required**
USCG Type B-1	**100g/m²/24hrs.**	**Not Required**
USCG Type B-2	**300g/m²/24hrs.**	**Not Required**

Table I

Installation Do's & Don'ts

Do	Don't
Use a Fuel Proof Pipe Thread Sealant when assembling fittings into fuel system components, (Locktite PST, Leak-Lock, or equivalent).	**Never use Teflon Tape!**
Use thin wall, low pressure, full flow type NPT or NPTF hose barb fittings.	**Don't use Push-Lok, or Barb-Tite fittings.** Avoid using JIC or SAE swivel fittings. **If used always install copper conical sealing washers, (Connie seals) or fitting seals on fittings.**
Double clamp all hose barb fittings.	Avoid using 90° elbow fittings.
Install Sensor(s) at a low point in the fuel system, as far from the engine as practical. Fuel must travel, "Up-hill" slightly after leaving the sensor. Verify correct orientation and fuel flow direction.	**If possible, avoid bolting or mounting sensor(s) directly onto the engine.**
Connect all, "Ground" wires to a Ground Buss, or directly to the Battery's Negative Terminal. Connect or, "Ground" wire shields to the engine block.	**Never connect Instrument or Sensor "Ground" wires to the hull, engine block, or other machinery.**
On Instruments with a GPS interface, connect FloScan's Data (+) to the GPS signal output. Connect Data (–) to the GPS signal ground.	**Do not connect FloScan's Data (–) to the GPS Data (–).**
Always use non-illuminated switches for Totalizer Reset, Port/Starboard Select, Hours/Synch, and GPH/MPG.	**Never use illuminated, or back-lit switches.**

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Series 7000/8000/9000 Gas Multifunction Instrument

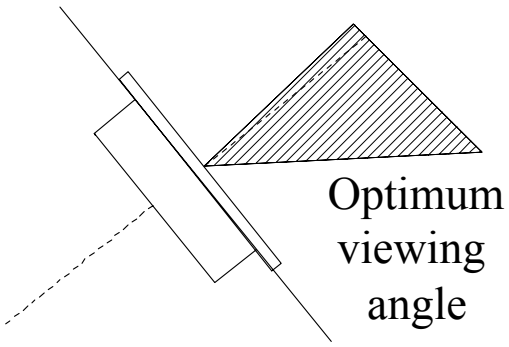
Series 7000(0)/8000(0)/9000(0) Gasoline Multifunction Instruments use a microprocessor-based, non-volatile Random Access Memory (RAM) to store engine hours and gallons of fuel consumed. Non-volatile RAM requires no power for memory retention.

All "8"s are displayed for the first 3 seconds when the instrument is powered up. For 1 second after that, the instrument shows switch positions and software version. After completing its start-up sequence, the instrument goes into normal operating mode. If supply voltage drops below 10 VDC on engine start-up, the instrument may flicker or display "8"s for about 2 seconds.

If supply voltage drops below 10 VDC, the instrument may flicker, display "8"s, or display a row of decimals across the bottom of the RPM window. This does not affect instrument accuracy. Stored engine hours and fuel consumption data will not be lost.

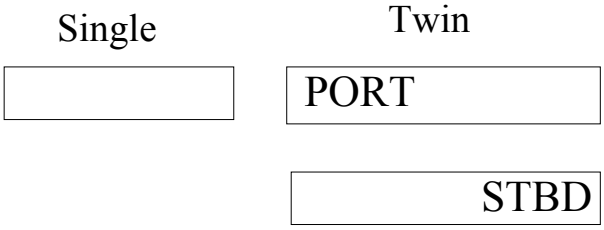
Liquid crystal displays have an OPTIMUM VIEWING ANGLE. If your viewing angle is outside this range, contrast will decrease and numbers may flicker.

Before drilling any holes in your dash, it's a good idea to temporarily power up the instrument (+12V DC to the RED wire on plug #9, 12V DC to the BLACK wire on plug #5) before installing it and see if the intended viewing angle is acceptable.



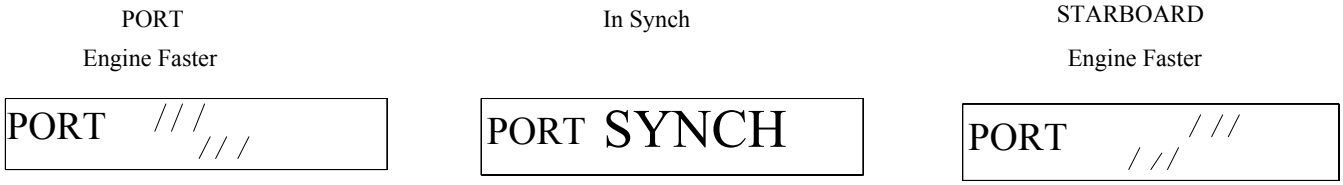
Engine Hours
The engine hour meter is shipped at or near zero hours. It accurately tracks the number of hours your engine has run. Unlike most hour meters, it only accumulates time when the engine is actually running. If the meter is turned ON, but the engine is NOT running, NO time is added to the engine hour display.

In twin engine installations, the HOUR window displays hours for the engine being viewed. The engine hour meter can only be reset at the factory.



Tachometer (RPM)
The Tachometer window shows engine speed to the nearest 10RPM.
On twin engine installations, the Hours window shows which engine you are looking at.

Synchronizer, (Twin Engine Models)
When the Hours/Synch switch is turned on a bar graph is displayed in the Hours window. The upper graph shows, which engine is turning faster, and the lower graph shows the slower, engine. The further out of synch your engines are, the longer the bar graph will grow. The Port engine always shows on the left and the Starboard engine always shows on the Right.



Flow Consumption (GPH, LPH)
The GPH/LPH window shows the rate at which your engine is consuming fuel. The GPH/LPH and Gallons/Liters readings will both change if the Black Calibration Switch on the back of the instrument is turned. On twin engine installations you'll see either the Port or Starboard engine fuel consumption.

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Totalizer (Gallons, Liters)
The Gallons/Liters window shows total fuel consumed. The GPH/LPH and Gallons/Liters readings will change if the Black Calibration Switch on the back of the instrument is turned. On twin engine installations, the totalizer displays consumption for both engines.

Totalizer Reset
When the totalizer-reset switch is closed, (Turned ON) the GALLONS/LITERS display will flash for ten seconds before resetting to zero, (Flashing indicates the instrument is in reset mode). If the RESET switch is opened, (Turned OFF) before the totalizer reads, "0.0" the instrument will NOT reset. If you neglect to turn OFF the RESET switch, "0.0" continues to flash.

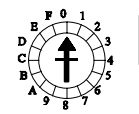
Sensor Selection
Referring to the table below, verify that the correct flow sensor has been selected by checking the recessed arrow switch setting on the back of the MFI instrument.

Synchronizer Setting
We suggest using the, "Standard" tachometer synchronizer setting. On this setting the synchronizer display will show that the engines are synched when running within 50 RPM of each other. The FINE setting shows that they're synched when running within 20 RPM. The COARSE setting shows they're synched when they are within 100 RPM.

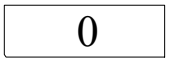
	FINE	STANDARD	COARSE
FLOW SENSOR	(Within 20 RPM)	(Within 50 RPM)	(Within 100 RPM)
20A	7	8	9
20B	F	0	1
231	3	4	5
233C	B	C	D

Examples:

20B Flow Sensor at
Standard 50 RPM increments

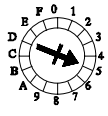


Recessed Arrow Switch

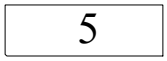


GPH Window

231 Flow Sensor at
Coarse 100 RPM increments



Recessed Arrow Switch



GPH Window

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Series 5400(0)/ 5500(0)/ 56100/ 7000(0)/ 8000(0)/ 9000(0)/ TwinScan® - GPH Instrument Gasoline Engines - Inboard/ I/O/ Outboard

FLOW SENSOR INSTALLATION

Flow Sensors must be placed in a horizontal section of fuel line at a low point in the fuel system. Fuel should travel, "Up-hill" when exiting the sensor. Its outlet should be at least 1 or 2 inches lower than the fuel pump inlet, priming bulb or pulsation damper, (if used). Pulsation Dampers and Priming Bulbs must also be mounted horizontally. Installing sensor(s) 12" upstream of the fuel pump, priming bulb or pulsation damper improves system accuracy. Install sensors in a protected location, away from water spray.

Model 20A, 20B, 231, & 233C gasoline sensors must be installed downstream of a fuel filter or water separator. On vessels not equipped with off engine filters, we suggest installing a Flow Ezy model ILA-02 filter with 238 micron screen directly to the 20A, 20B or 231 Low-Flow Sensors' inlet. Use model 4ILA-04 with 595 micron screens with High Flow 233C Sensors'.

Flow Ezy can be reached at (800) 237-1165.

Caution: NEVER install sensor(s) downstream of an engine mounted fuel filter. NEVER use Teflon Tape when installing sensors. Teflon Tape can jam a sensor's rotor. Instead, always use a fuel proof pipe thread sealant.

For proper system operation, Carburetor Inboard & I/O Engines having diaphragm fuel pumps require Gasoline Pulsation Dampers. FloScan Systems are not shipped with Pulsation Dampers' as carburetor Inboard and I/O engines are no longer in production. If you have a Carburetor Inboard or I/O engine, Pulsation Dampers can be purchased factory direct. Standard Flow Dampers' are $30.00 each and High Flow Dampers' are $45 each. Damper orders ship via UPS-3 day on purchase date. Prices include shipping and handling.

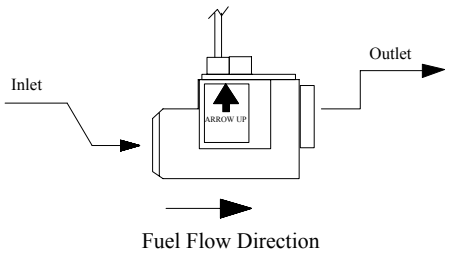
To order please contact FloScan Sales or Service, (206) 524-6625, X-306, 316, 309, or 302.
E-mail: sales@floscan.com, or service@floscan.com.

The following engine types DO NOT require Pulsation Dampers:

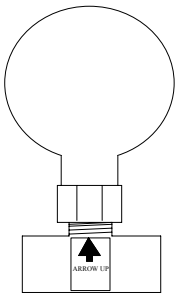
- **Outboard Gasoline Engines Including Ficht, Optimax, 2 & 4-Cycle.**
- **Closed Loop EFI Gasoline Outboard, Inboard, and I/O Engines.**
- **Open Return EFI Gasoline Inboard and I/O Engines.**

- Sensors are marked with orientation and fuel flow arrows. They must be installed with these arrows pointing in the right direction.

20A/ 20B/ 231 SENSOR



Standard-Flow Pulsation Damper



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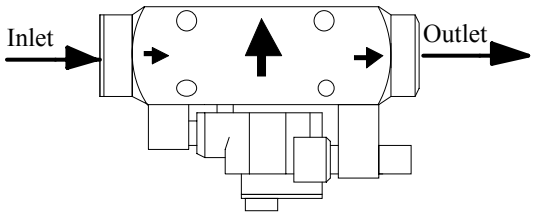
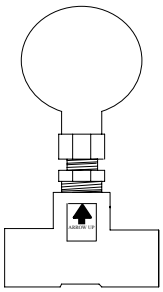
High-Flow Pulsation Damper

233C SENSOR





- Install sensor(s) with orientation arrows pointing UP ↑. Fuel must enter through the port marked IN or with an inward pointing ➔ fuel flow arrow, and exit through the port marked OUT or with an outward pointing ➔ arrow.

- The sensor must be installed horizontally at a low point in the fuel system. When fuel exits the sensor it must travel up-hill slightly. One or two inches of vertical rise is adequate, more is ok.

- The sensor must be installed downstream of, and protected by a screen, filter, or water separator. Sensors are tolerant of fine debris. A coarse screen, (up to 800 microns) or water separator is all that is required.

- It is recommended that the sensor be installed between the fuel filter and fuel pump inlet. There should be at least twelve inches of fuel hose, (more is ok) between the sensor and fuel pump inlet.

- If required, the pulsation damper must be installed horizontally, with its orientation arrow pointing up, (refer to fuel flow schematics below).

- **Minimize the number of 90º elbows and pipe fittings.** Excessive use may create a high vacuum, fuel restricting pressure drop across the fuel system. Whenever possible, use a large radius hose bend instead of elbows. Refer to the engine owner's manual for maximum fuel pump vacuum. A vacuum gauge can be used to confirm that the system is within limits.

- If swivel fittings are used, (JIC or SAE) their mating surfaces should be sealed with AP 50 Copper Conical Sealing Washers or Flaretite Fitting Seals. Seals and sealing washers can be purchased through Fittings Inc. in Seattle, WA (206) 767-4670, 1-800-552-0632, or a local hydraulic supply house.

CAUTION, DO NOT OVER TIGHTEN FLOW SENSOR FITTINGS. Over-tightening may crack the sensor's body. Cracks cause leaks and fuel leaks sometimes cause catastrophic explosions and fire.

Torque pipe thread fittings to a maximum of 15 ft-LB, (180 inch-LB) or two full turns beyond hand tight, (Whichever comes first). Use a fuel proof pipe thread sealant be used when installing fittings into the flow sensors, (LockTite PST, Rector Seal, Jomar, etc).

INSTRUMENT INSTALLATION

- Before cutting holes in your Instrument Panel, verify that the instrument will be installed approximately 12" away from the compass, and in a shaded location out of direct sunlight. Mounting it within 12" of a compass may interfere with compass operation. Direct sunlight may cause the LCD display to temporarily turn black due to heat.

Instrument Series	Cutout Size	Instrument Depth
5400(0), 5500(0)	3 1/16"	3" – Console Panel Thickness
7000(0), 8000(0), 9000(0), TwinScan®	3 3/8"	2 ½" – Console Panel Thickness

Table 1

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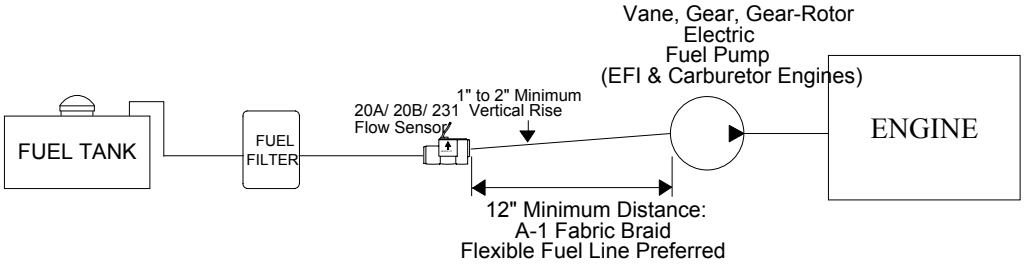
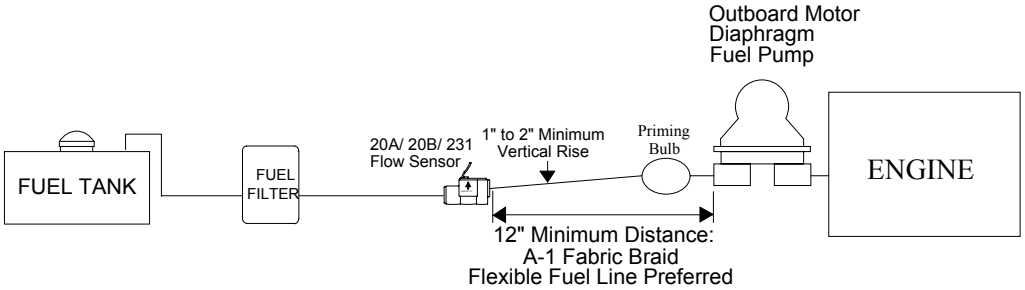
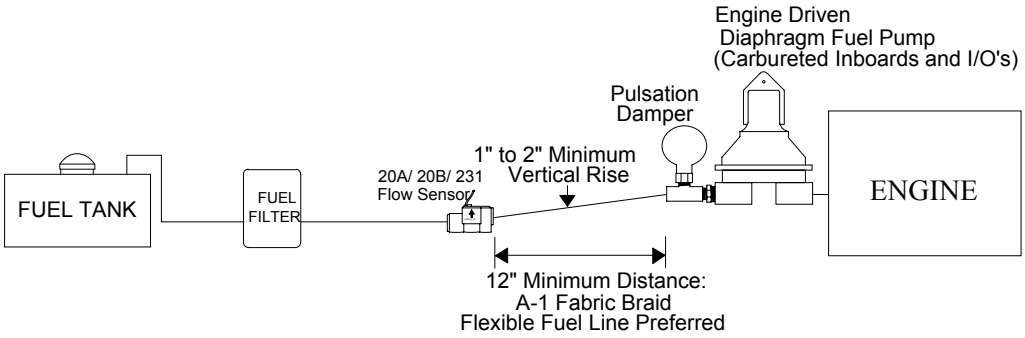
Standard-Flow Gasoline System Schematics







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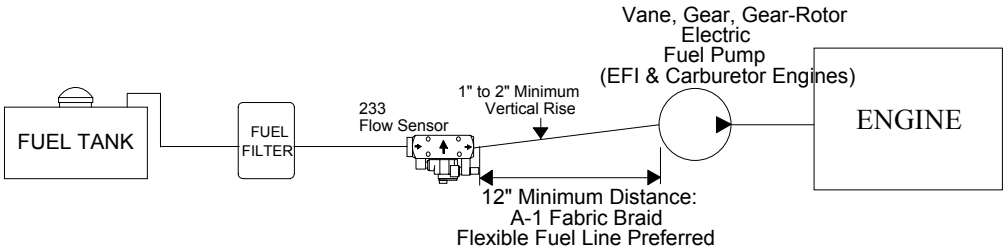
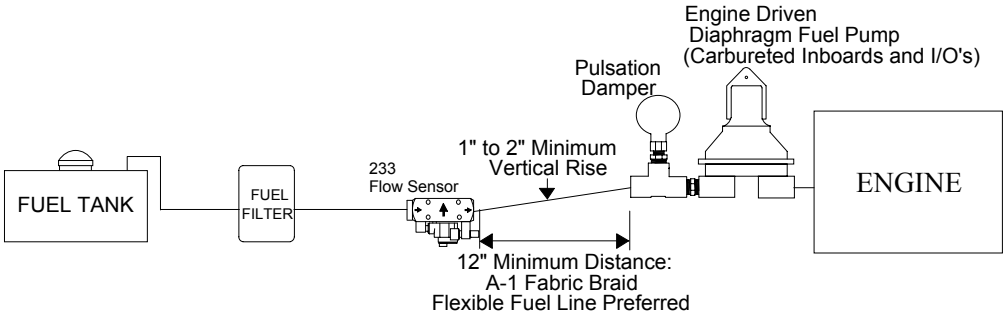
High-Flow Gasoline Fuel Flow Schematics





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Series 9000 Multifunction Instrument
Gas - NMEA 0183 Input

This unit conforms to NMEA 183, Version 1.5 and 2.0 interface standards and requires a message that includes "VTG", "GPRMC" or "LCRMA". Check your owner's manual to verify your GPS /LORAN-C includes this information. To insure an easy trouble free installation, read all instructions before starting.

Wiring

1. Refer to the electrical wiring section of the GPS / LORAN-C Owner's Manual for the proper procedure to connect your GPS / LORAN-C to NMEA 183 devices. Use shielded wire between instruments and ground the shield ONLY at the GPS / LORAN-C (sender end), not at the FloScan instrument end (receiver end). The shield is not to be used as a ground path.

2. Connect the WHITE/ORANGE wire (terminal #15, FloScan instrument) to the NMEA "(+)"(BNC center terminal) terminal coming from your GPS / LORAN-C instrument.

3. Connect the GREEN/BLACK wire (terminal #7, FloScan instrument) to the NMEA "(-)" (BNC shield) terminal coming from your GPS / LORAN-C instrument.

4. Connect the GRAY wire (terminal #2, FloScan instrument) to one terminal of a single pole, single throw switch. Connect the BLACK wire (terminal #13, FloScan instrument) to the other terminal.

Calibration

1. See your GPS / LORAN-C owners manual and set output for NMEA 183. Speed is always sent as speed over ground in knots no matter what units your GPS / LORAN-C displays.
2. Fuel flow rate calibration is automatically done when the totalizer is calibrated. To calibrate, see the Totalizer calibration instruction page.

MPG/GPH Operation

With the MPG/GPH switch in the OFF position, your instrument displays engine fuel flow (in twin engine installations, the engine selected by the port/stbd. switch). In the ON position, fuel mileage (speed over ground in Knots /all fuel being consumed) is shown as "**0.00**" to "**9.99**", then "**10.0**" to "**99.9**". You must have a valid NMEA 183 version 1.5 or 2.0 speed and RPM from at least one engine to display fuel mileage; otherwise you receive an error code:

Error Codes:

Display	Reason	Cause
OFF	No signal activity present on NMEA 0183 terminals for four seconds	GPS / LORAN-C OFF NMEA OUTPUT not selected Leads not connected (+) & (-) leads reversed
- - -	Receiving NMEA 0183 Version 1.5 or 2.0 message, but speed message is invalid.	GPS satellite reception is poor GPS / LORAN-C in startup mode
-0 -	No RPM reading (twin-both engines). Valid NMEA 0183 speed message present.	Engine(s) not running Tachometer leads not connected to instrument
Er1	Some pulsing signal present but no NMEA 0183 message received in last four seconds	Leads connected to wrong source GPS / LORAN-C set to NMEA 0180 or 0182 (+) & (-) leads reversed.
Er2	NMEA 0183 message detected. Missing "VTG", "GPRMC" or "LCRMA" sentence.	GPS / LORAN-C incompatible with NMEA 0183, version 1.5 or newer

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During normal vessel operation, adjusting engine RPM to your maximum MPG (MPL) reading maximizes your fuel mileage. Vessel trim, load, adjustment of trim tabs, water currents and weather conditions also affect your fuel consumption. For similar operating conditions, dramatic changes in MPG (MPL) readings indicate possible mechanical malfunction or excessive bottom fouling and should be investigated.

Your current MPG (MPL) and GALLONS (LITERS) readings allow you to quickly and easily estimate your current maximum cruising radius. For safety, allow a margin of error when calculating your next fuel stop.

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Series 5400(0)/5500(0)/56100/5800(0)/6500(0)/6600(0) AccuTroll & CruiseMaster, All Multi Function Instruments, & TwinScan®

SET UP

Wire & Switches: Use 18 AWG stranded wire on runs under 50'. For runs over 50' use 16 AWG. Shielded wire is recommended for all Diesel systems and suggested for Inboard & I/O gasoline systems. Always, "Ground" the wire shield or shield drain wires in the engine room by connecting them to the bonding system or engine block. The double wiring harness for twin engine Pulse/NMEA Diesel installations is included in all, (97/9800(0)) kits. FloScan suggests using J-Boxes, Terminal Blocks, and three conductor cables between diesel sensors and instrument to make wiring easier.

Install Single Pole Single Throw (SPST) switches for Totalizer Reset, Port–Starboard Select, Engine Hours / Synchronizer, and GPH / MPG, (switches are not included with kit). To determine which switch types are required for your system, refer to the table below. All instruments except TwinScan Tachometers require a totalizer reset switch.

SYSTEM	TOTALIZER RESET	PORT/STBD Twin Engine Systems	HOURS/ SYNCH	GPH/ MPG	MPG/ SYNCH
2500	SPST or Momentary ON	SPST	NA	NA	NA
5400(0)	SPST or Momentary OFF	SPST	NA	NA	NA
5500(0)/56100	SPST or Momentary OFF	SPST	NA	NA	NA
5800(0)	SPST or Momentary OFF	NA	NA	NA	NA
6500(0)/6600(0)	SPST or Momentary OFF	NA	NA	NA	NA
65/6600(0) Cummins PT	SPST or Momentary OFF	SPST	NA	NA	NA
7000/8000 Gasoline MFI	SPST or Momentary ON	SPST	SPST	NA	NA
75/7600(0) Diesel MFI	SPST or Momentary ON	NA	NA	NA	NA
9000 Gasoline MFI	SPST or Momentary ON	SPST	SPST	SPST	NA
95/96/97/9800(0)	SPST or Momentary ON	NA	NA	SPST	NA
TwinScan GPH Meter	SPST or Momentary ON	NA	NA	NA	NA
TwinScan Tachometer	NA	NA	NA	NA	NA
TwinScan GPH & Tachometer	SPST or Momentary ON	NA	NA	NA	SPST

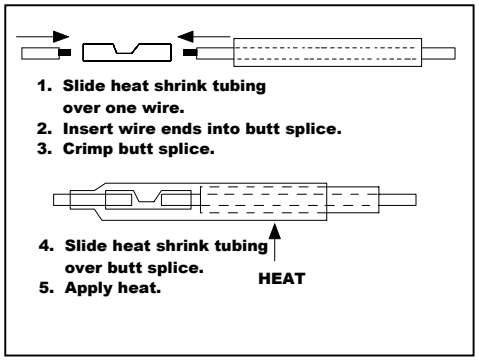
NA = Not Applicable

Grounding: Each Black sensor wire must be connected directly to the Black, "Instrument Ground" wire. Use a single wire to connect the Black wire junction to the battery's negative terminal, or a ground buss.

Power: FloScan Instruments & sensors operate on 9 to 12 VDC. Voltages exceeding 16 VDC will damage equipment. 24 & 32 VDC systems must be reduced to 12 VDC. Two different types of voltage reducers are available through FloScan.

WIRE CONNECTIONS

Installation: Connect wires one at a time and install heat shrink tubing before proceeding to the next wire, (refer to diagram). Connect ground wires first, (BLACK instrument ground wire to the BLACK sensor wires). Connect this junction to the battery's negative terminal or the ground buss. Connect all other wires leaving the Red power wires for last to prevent short circuits during installation.


1. Slide heat shrink tubing over one wire.
2. Insert wire ends into butt splice.
3. Crimp butt splice.
4. Slide heat shrink tubing over butt splice.
5. Apply heat.
HEAT

Splicing: Splice or join individual wires per the diagram. Slide heat shrink tubing over the splices to prevent shorts. Do not seal splices until the installation is finished and has been tested.

An adequate number of crimp-on connectors and heat-shrink tubing are included with system. The heat-shrink is a special type that will bond to wire insulation and make a watertight connection. See diagram for proper tubing application. Crimp-on connectors are sized for 18 or 20 gauge stranded wire.

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Tachometer Wiring Information applies only to MFI & TwinScan Instrument Tachometers

Tachometer signal wires on MFI & TwinScan Tachometers should be shielded.

For proper tachometer operation on gasoline EFI engines, (especially outboards) the engine Ground wire must be physically connected to the MFI or TwinScan instrument ground wire.

Note: FloScan recommends using dedicated 18 AWG shielded cable for tachometer signal wire connections. Always, "Ground" wire shields or the shield drain wire in the engine room by connecting to the bonding system or engine block.

MULTI FUNCTION & TWINSCAN INSTRUMENT TACHOMETERS for CARBURETOR & CLOSED LOOP EFI GASOLINE ENGINES with POINTS or STANDARD ELECTRONIC IGNITIONS

Inboard, & I/O Engines: Connect the YELLOW wire from pin # 8 to the distributor coil's negative terminal. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the VIOLET wire from pin # 16 to starboard.

Outboard Engines: Outboard tachometers are connected to either the engine alternator or tachometer signal wire. Connect the YELLOW wire from pin # 8 to the engine alternator or tachometer signal wire. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the VIOLET wire from pin # 16 to starboard.

MULTI FUNCTION & TWINSCAN INSTRUMENT TACHOMETERS for CLOSED LOOP EFI GASOLINE ENGINES with CPU IGNITION SYSTEMS

Inboard, I/O, & Outboard Engines: Connect the YELLOW wire from pin # 8 to the engines' tachometer signal wire. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the VIOLET wire from pin # 16 to starboard.

Outboard Engines: Connect the YELLOW wire from pin # 8 to the engines' tachometer signal wire. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the VIOLET wire from pin # 16 to starboard.

MULTI FUNCTION INSTRUMENT TACHOMETERS for OPEN RETURN EFI GASOLINE ENGINES with CPU IGNITION SYSTEMS

Inboard & I/O Engines: Connect the YELLOW wire, pin # 8 to the engines' tachometer signal wire. Connect the VIOLET wire, pin # 16 to ground.

MULTI FUNCITON INSTRUMENT TACHOMETERS - DIESEL ENGINES

- Keep existing tachometer: Connect the YELLOW and VIOLET wires to the existing tachometer signal wires. If one lead is grounded at the pickup or alternator, connect the YELLOW wire to the tachometer signal wire. Connect the VIOLET wire to a ground buss.

- Replace existing tachometer: Connect the YELLOW and VIOLET wires to the existing magnetic pickup or signal generator. If one lead is grounded at the pickup or alternator, connect the YELLOW wire to the existing signal wire terminal at the tachometer and connect the VIOLET wire to a ground buss.

- Install as a new tachometer. On engine alternator installations, connect the YELLOW wire to the tachometer output terminal (usually marked "tach" or "sig") and connect the VIOLET wire to a ground buss. For mechanically driven A-C signal generators and magnetic pickups, connect the YELLOW wire to one terminal and the VIOLET wire to the other.

TWINSCAN INSTRUMENT TACHOMETERS – DIESEL ENGINES

- Connect the YELLOW wire to one terminal the Port tachometer sender, (AC signal generator, Magnetic pickup, or the engines' alternators tach or sig terminal). Connect the VIOLET wire to the Starboard sender. The tachometer senders' second terminal must be grounded.

FINAL ACTIONS

Check Electrical Installation: Test all connections. Support and secure all dangling wires. Start engine and calibrate system.

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Series 7000/8000/9000 Gasoline Multifunction Instruments

Port/Starboard Select Switch: Twin engine operation requires a Single Pole Single Throw, (SPST) switch. The select switch allows you to display RPM & GPH readings for either PORT or STARBOARD engine. Connect one side of the switch to the BLUE wire from pin #11. Connect the other side to the Black wire on pin # 15. The MFI displays Port readings when the switch is open, Starboard readings when closed.

Totalizer Reset: The instrument requires a Single Pole Single Throw, (SPST) to reset its Totalizer, (Gallons or Liters Window). Either a momentary ON or standard ON/OFF switch can be used. To reset, close or turn the reset switch ON and hold for approximately 15 seconds. Once cleared open, or turn the switch OFF for normal operation.

Engine Hour Meter: The engine hour meter can not be reset.

Engine Synchronizer: On twin installations the HOURS window can be adapted to function as a synchronizer display. To operate as a synch display a Single Pole Single Throw ON/OFF switch must be connected between the White/Yellow wire on pin # 3 and the Black wire on pin # 7. Refer to the **Wiring Diagram.**

Illumination: Connect the Orange wire from pin # 4 to illumination circuit, or to a 12 VDC power source.

Tachometer Wiring: For proper tachometer operation on EFI engines, (especially outboards) the engine Ground wire must be directly connected to the MFI instrument ground wire. FloScan recommends using dedicated 18 AWG shielded cable for tachometer signal wire connections. Always, "Ground" wire shield or shield drain wire in the engine room by connecting it to the bonding system, or engine block.

CARBURETOR & CLOSED LOOP EFI GASOLINE ENGINES with POINTS or STANDARD ELECTRONIC IGNITIONS

Inboard, & I/O Engines: Connect the Yellow wire from pin # 8 to the distributor coil's negative terminal. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the Violet wire from pin # 16 to starboard.

Outboard Engines: Outboard tachometers are connected to either the engine alternator or tachometer signal wire. Connect the YELLOW wire from pin # 8 to the engine alternator or tachometer signal wire. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the VIOLET wire from pin # 16 to starboard.

CLOSED LOOP EFI GASOLINE ENGINES with CPU IGNITION SYSTEMS

Inboard, I/O, & Outboard Engines: Connect the Yellow wire from pin # 8 to the engines' tachometer signal wire. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the Violet wire from pin # 16 to starboard.

Outboard Engines: Connect the Yellow wire from pin # 8 to the engines' tachometer signal wire. On twin engine systems the Yellow wire from pin # 8 connects to the port engine, the Violet wire from pin # 16 to starboard.

CHRYSLER (Except Magnapower I) - Connect tachometer signal wire(s) to the engine terminal strip marked, "ALT".

JOHNSON/EVINRUDE/SEADRIVE - Connect tachometer signal wire(s) to the gray wire at key switch harness or Gray/Yellow alternator wire on engine terminal strip. For 1984 and later model years with standard voltage regulators, connect the tachometer signal wire(s) to either the Gray voltage regulator wire, or the Yellow/Gray alternator wire on the engine terminal strip.

MERCURY/MARINER - Attach tachometer signal wire(s) to the Yellow/Red, or Yellow wire terminal on engine rectifier.

SUZUKI - Remove three screws from rear of the throttle control box and remove cover plate. Attach tachometer signal wire(s) to the Yellow wire, and shield ground wire to Black wire. Keep wires away from the moving parts in control box and reinstall back cover.

YAMAHA - Attach tachometer signal wire(s) to the Green wire, and shield ground wire to the Black wire at underside of shift control box. If the Green wire is not accessible at control box, either Green wire on engine terminal strip can be used.

- Refer to calibration page for switch settings.

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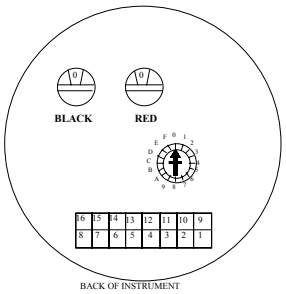
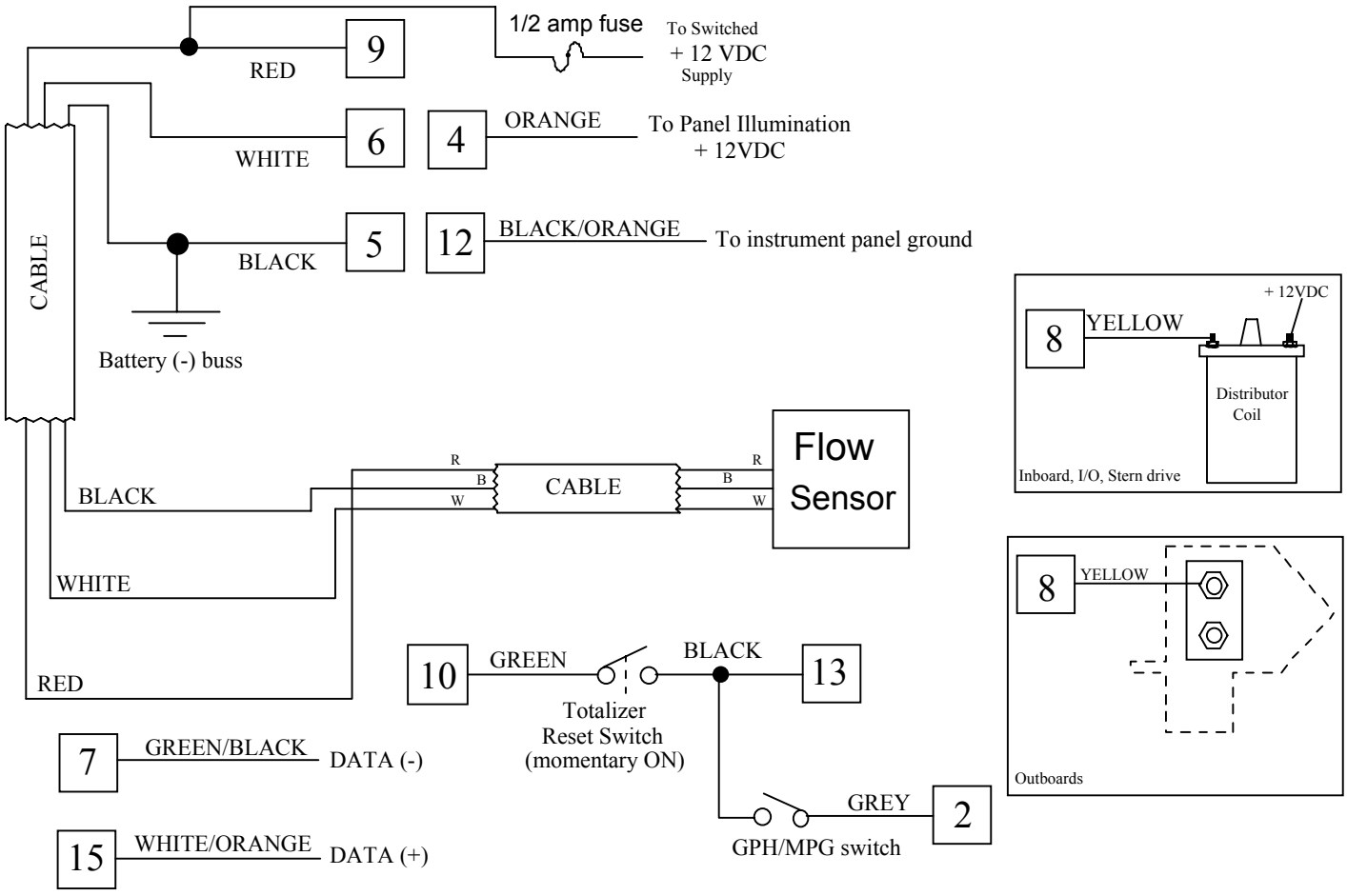
WIRING DIAGRAM

Series 9000 Multifunction Instrument with NMEA 0183 Input

PIN #	*FUNCTION*	*PIN #*	*FUNCTION*
1	*RED* not connected	9	*RED* + 12VDC
2	*GREY* GPH/MPG switch	10	*GREEN* Totalizer Reset switch
3	*WHITE/YELLOW* not connected	11	*BLUE* not connected
4	*ORANGE* Illumination + 12VDC	12	*BLACK/ORANGE* Illumination ground
5	*BLACK* Instrument Ground	13	*BLACK* all switches ground
6	*WHITE* flow sensor	14	*BROWN* not connected
7	*GREEN/BLACK* Data (-) NMEA "B"	15	*WHITE/ORANGE* Data (+) NMEA "B"
8	*YELLOW* tachometer input	16	*VIOLET* not connected



Single Sensor Installations



(Please see reverse side for twin engine installations)

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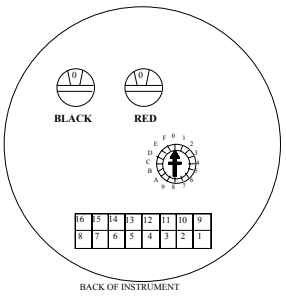
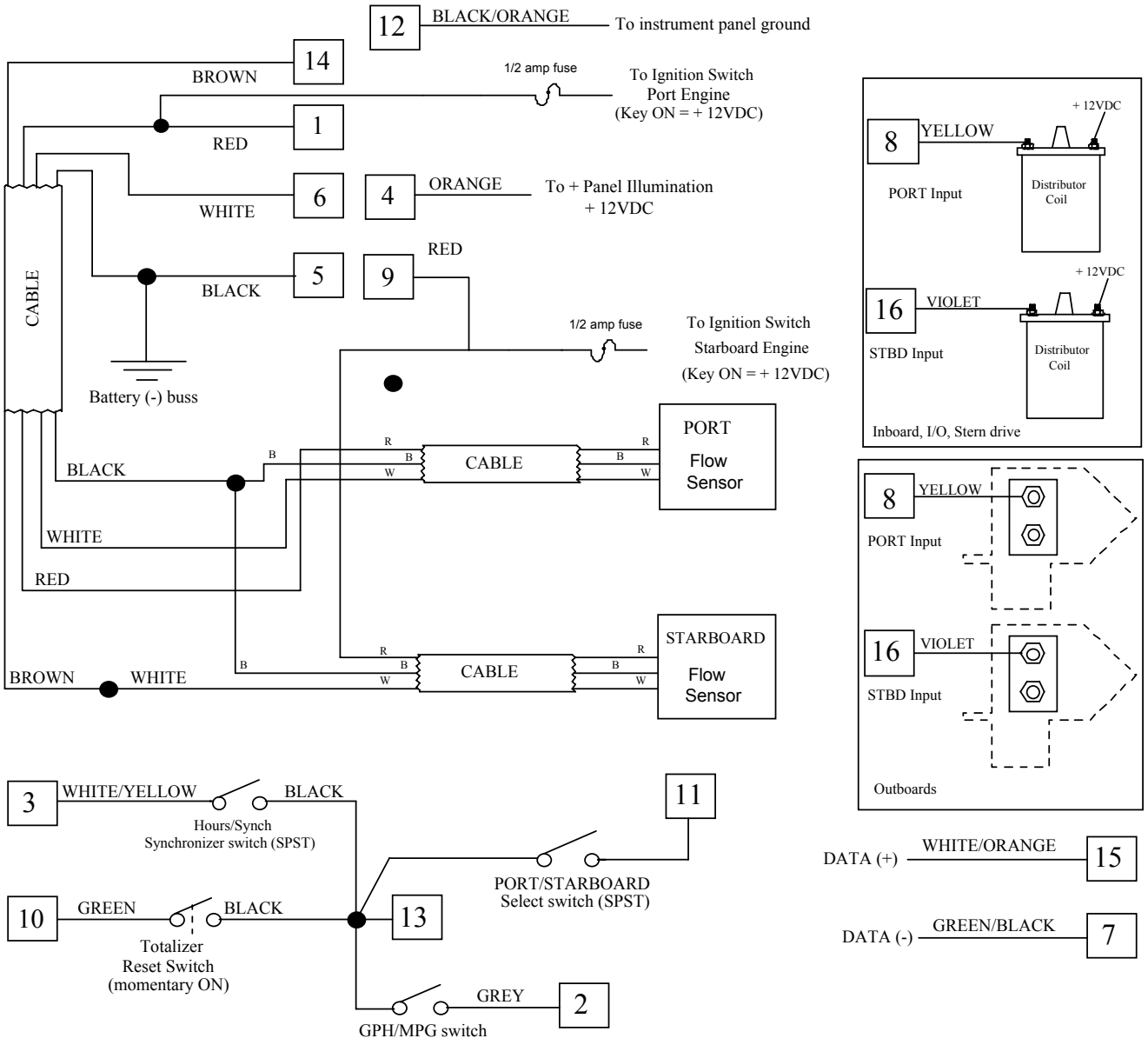
PIN #	*FUNCTION*	*PIN #*	*FUNCTION*
1	*RED* *PORT* + 12VDC	9	*RED* *STARBOARD* + 12VDC
2	*GREY* GPH/MPG switch	10	*GREEN* Totalizer Reset switch
3	*WHITE/YELLOW* Engine synchronizer/Hours	11	*BLUE* *PORT/STBD* switch
4	*ORANGE* Illumination + 12VDC	12	*BLACK/ORANGE* Illumination ground
5	*BLACK* Instrument Ground	13	*BLACK* all switches ground
6	*WHITE* *PORT* flow sensor	14	*BROWN* *STARBOARD* flow sensor
7	*GREEN/BLACK* Data (-) NMEA "B"	15	*WHITE/ORANGE* Data (+) NMEA "B"
8	*YELLOW* *PORT* tachometer input	16	*VIOLET* *STARBOARD* tachometer input



Forward and Return Sensor and Twin Engine installations



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CALIBRATION

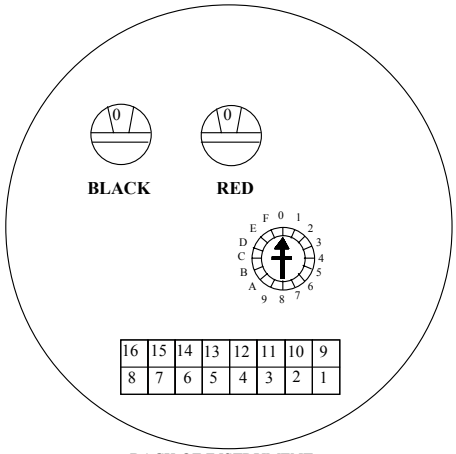
Series 7000/8000/9000 Multifunction Instrument

There are two calibration switches on the back of the Multifunction Instrument, Black and Red. The Black switch is used for fuel totalizer calibration. The Red switch is used for tachometer calibration.

TACHOMETER SELECTION

Inboard Engines:

Tachometer calibration for standard point and electronic ignition inboard engines is usually based upon the number of engine cylinders. EFI engines sometimes use a CPU to generate its tachometer signal. For these engines calibration is not always based on engine cylinders.



BACK OF INSTRUMENT

Standard Point, Electronic Ignition, & EFI Inboard Engines:

Cylinders	CPU, (4,6,8)	4	6	8
Red Switch Setting	1	1	2	3

Outboard Engines:

Tachometer calibration for standard point and electronic ignition outboard engines is usually based upon the number of alternator pole pairs. EFI outboards sometimes use a CPU to generate its tachometer signal. Calibration for EFI engines is not always based on alternator pole pairs. Refer to your engine manual or check with a local dealer to determine the number of alternator pole pairs your engine has.

Standard Point, Electronic Ignition, & EFI Outboard Engines:

Pole Pairs	CPU	4	6	8	10	12	14	16	18	20
Red Switch Setting	1	1	2	3	4	5	6	7	8	9

TOTALIZER CALIBRATION, (Inboard & Outboard Engines):

- Reset the totalizer so that the GALLONS window reads zero. Top off the fuel tank(s).
- Take the vessel for a cruise. Once underway, operate the boat the as you normally would.
- Consume a minimum of 15 to 30 gallons of fuel per engine. Higher consumption gives better accuracy.
- After consuming some fuel, return to the fuel dock and top off the fuel tank(s).
- Compare the Gallons window reading to the fuel pump reading.
- Calculate the percentage difference between the fuel pump & Gallons window readings; **(Refer to Examples I & II on page 2).**
- Determine if the totalizer is reading High or LOW.
- Rotate the **Upper Black Switch** until the **GALLONS** window matches the fuel pump reading.
- Starting at, "0" rotating the Upper BLACK Switch clockwise, increases the Totalizer readings by 1% for each click.
- Rotating the switch in a counter-clockwise direction decreases Totalizer readings by 1%.
- Totalizer readings can be increased by 5%, or reduced by 10%.

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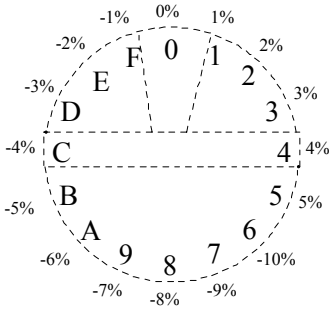
Example 1: Twin engine vessel with two dedicated fuel tanks, (For single engine vessel with single tank, see Example 2).

After steaming and returning to refuel. The Port tank took 91.6 gallons, and the Starboard tank took 93.2 gallons. Total fuel consumption is 184.8 gallons, and the totalizer reading is 181.1 gallons.



Upper BLACK switch

- Using the formula, calculate the percentage difference between the totalizer reading and actual fuel consumption.

$$\frac{\text{Difference in Gallons}}{\text{Totalizer Reading}} \times 100$$

- Find the difference between the totalizer and fuel pump readings:
  (184.8 gallon fuel pump reading) - (181.1 gallon totalizer reading) = 3.7 gallon difference between readings.

- Determine percentage difference between readings:
  (3.7 gallon difference) ÷ (181.1 gallon totalizer reading) = .020 x 100 = 2% <u>Lower</u> difference, (Totalizer reads low).

- To calibrate, rotate the MFI's Black Switch Clockwise to position # 2, increasing totalizer reading by 2%.

Example 2: Single engine vessel with single fuel tank.

After steaming and returning to refuel the fuel tank took 91.5 gallons. The totalizer reads 94.4 gallons.

- Using the formula, calculate the percentage difference between the Totalizer reading and actual fuel consumption.

$$\frac{\text{Difference in Gallons}}{\text{Totalizer Reading}} \times 100$$

- Find the difference between the totalizer and fuel pump readings:
  (**94.4 gallon totalizer reading) – (91.5 gallon fuel pump reading) = 2.9 gallon difference between readings.**

- Determine percentage difference between readings:
  (**2.9 gallon difference) ÷ (94.4 gallon totalizer reading) = .030 x 100 = 3% <u>Higher</u> difference, (Totalizer reads high).**

- To calibrate, rotate the MFI's Black Switch Counter-Clockwise to position D, reducing its' totalizer reading by 3%.

This completes system calibration. The Instrument should be within 3-5% of actual consumption. Calibrating a second time should bring it to within 1-3% especially on twin engine vessels. Larger fuel burns increase calibration accuracy.

Drastically changing operating habits, (Changing from mostly cruising to mostly trolling) may affect totalizer accuracy. If this occurs, re-calibration may be necessary.

NOTE: Instrument calibration affects both the totalizer, (GALLONS) and GPH readings.

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